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EPA

Greening EPA

A Look at Agencywide Environmental Progress **Volume One**

The mission of the U.S. Environmental Protection Agency is to protect human health and to safeguard the natural environment—air, water, and land—upon which life depends.

Welcome!

Welcome to the first edition of *Greening EPA,* formerly *Conservation News*. We have changed the name and changed the look of our newsletter to more accurately reflect our mission. As EPA employees, we are responsible not only for keeping EPA facilities operating smoothly, but for ensuring the facilities are operating in a manner that is consistent with EPA's mission. This means we should always strive to reduce the adverse environmental impacts associated with facility operation by increasing energy efficiency, using recycled-content products, switching to renewable energy sources, and implementing other environmentally friendly activities.

This premiere issue of *Greening EPA* is a special edition focusing on recent environmental successes by the National Vehicle and Fuel Emissions Laboratory (NVFEL) in Ann Arbor, Michigan. Using an Energy Savings Performance Contract (ESPC), NVFEL is demonstrating for the rest of us how to improve a facility's environmental performance and save money. Many of the benefits achieved by NVFEL can be applied elsewhere. I hope you find the information interesting.

—Phil Wirdzek, FMSD

ESPC Saving Energy and Money at NVFEL

EPA's National Vehicle and Fuel Emissions Laboratory (NVFEL), located in Ann Arbor, Michigan, is part of the Office of Air and Radiation and is charged with implementing the Clean Air Act. Built in 1970, NVFEL is a 135,000-square-foot complex consisting of one main high bay building, an office building, and numerous temporary trailers. The primary function of this facility is to test mobile sources of pollution (e.g., cars, trucks, motorcycles, boats) to determine compliance with national standards. New transportation technologies also are tested for their emissions potential.

NVFEL incurs annual utility costs of $1.08 million (1993 through 1995 averages) for electricity, natural gas, and water, and an additional $350,000 for repair and maintenance of aging equipment. This seemingly large energy consumption is due in part to the stringent conditions that must be maintained in the laboratory environment. Test cells must be kept at tight-tolerance temperatures despite large fluxuations in heat being produced by changing the speed of the test engines. The nature of the test equipment requires substantial air flow (50 air changes per hour) to maintain indoor air quality.

To meet its mission to protect the environment, EPA is upgrading the facility's physical plant to reduce source emissions. An Energy Savings Performance Contract (ESPC) is being used to finance and construct the upgrade. The ESPC will allow EPA to leverage the facility's existing utility and operations budgets to implement this capital-intensive project.

Motivation for this Project

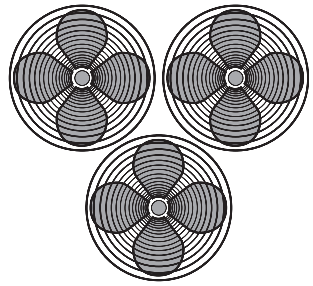
EPA initiated this project in cooperation with the Department of Energy's (DOE's) Federal Energy Management Program (FEMP) to optimize the ESPC mechanism as a means of achieving high-energy efficiency, minimizing power generation emissions, attracting private capital investment, and encouraging utilization of advanced building system technologies and concepts in the operations of federal laboratories.

PROJECT GOALS AND APPROACH

To reduce source emissions, energy consumption, and energy costs, EPA set the following goals for this ESPC:

- Exceed Federal Energy Reduction Mandates as prescribed by the Energy Policy Act of 1992 (EPAct) and Executive Order 12902, which require federal facilities to reduce their energy use by 30 percent by 2005, relative to a 1985 baseline.
- Reduce power plant source emissions.
- Optimize energy cost savings.
- Restore aging and obsolete infrastructure.
- Eliminate chlorofluorocarbons (CFCs).
- Minimize wasted energy.
- Maximize use of waste energy streams.
- Use renewable energy technologies.

The project will employ a two-pronged approach. Initially, the project team will focus on reducing the amount of energy consumed at NVFEL, and then will work on maximizing the efficiency of the equipment generating the energy. To optimize energy cost savings, the team will evaluate an extensive list of possible energy conservation measures (ECMs), weigh the merits of certain combinations of ECMs, calculate the effect of any relevant rebate programs or more favorable rate structures, and determine the optimal energy conservation system (ECS). Quick payback measures will be used to support the costs of longer payback measures, resulting in a comprehensive project that addresses energy and water consumption for the entire facility. A new 1,000-point energy management system will track the building's energy-consuming equipment, monitor alarms, and interact with the facility security and fire systems.



IMPROVEMENTS IN VENTILATION

The team began the project by evaluating the potential reductions in energy consumption outside of the process loads. The largest energy cost to EPA in this facility is operating existing air handling units (AHUs) at full ventilation air flows. A review of the HVAC systems has indicated more than 2 cubic feet per minute (cfm) of ventilation air is provided per square foot to the facility. (A typical office environment might have 0.2 cfm per square foot (sf), and a typical manufacturing facility might use 0.5 cfm/sf.) Under the present configuration, each air handling unit cools, dehumidifies, humidifies, and reheats the air supply to meet the facility's space conditioning requirements. New direct digital controls, cooling equipment, and reconfigured AHUs will allow 80 percent return air in the test facilities. As a result, NVFEL will use 22 percent less air flow and 60 percent less outside air.

Replacing the AHUs will incorporate a number of energy saving technologies. Thirty-four AHUs will be replaced, six of which already mix return air with outside air. Twenty-four of the new units will incorporate a return air component, as opposed to the 100-percent outside air configuration now used. These units will use a design that decouples the outside air load and conditions it separately. This will minimize the amount of energy required for dehumidification and reheating in the summer, and heating, humidifying, and reheating in the winter.

Bottom Line Savings

Once fully implemented, the project will reduce NVFEL's energy consumption by an anticipated 66 percent to 193,460 Btu/sf, lower energy costs by 74 percent to approximately $268,000, and reduce water consumption by 24 million gallons, an 80 percent decrease. The building's heating and cooling infrastructure will be completely replaced to improve performance and lower maintenance. This comprehensive approach to energy conservation will exceed all federal energy savings guidelines and bring the facility into the 21st century with strong environmental performance.

Sponsors

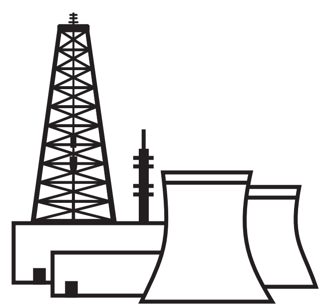
EPA pursued the comprehensive HVAC retrofit to demonstrate and support the systems integration objectives of the Advanced Building Systems Integration Consortium. This organization is sponsored by the National Science Foundation Industry/University Cooperative Research Consortium at the Center for Building Performance and Diagnostics, Carnegie Mellon University, Pittsburgh, Pennsylvania. EPA, DOE, other federal agencies, and major private corporations participate in this consortium.

Several air-moving devices were evaluated. Plug fans were selected because they offer the highest efficiencies at the lowest sound criteria. Placing the fans and motors in the air stream will assure that the fan motor energy adds to the air stream and assists in reheating the air, reducing the reheat coil load. This load, if placed in a blow-through configuration, would add to the AHU cooling load. The AHUs also will use indirect evaporative cooling to pretreat the outside air and lower the site cooling requirements. Evaporative cooling for this facility is effective due to the high return air temperatures that are a byproduct of the laboratory process. This technology will remove an additional 120 tons of cooling from the physical plant load. In offices and preparation rooms, variable air volume systems will be installed to reduce fan energy consumption. Premium efficiency motors will be installed on all new equipment and on the remaining exhaust fans.

Four AHUs will remain 100-percent outside air units due to the requirements of the facility. For these units, the exhaust air for the space will be cycled through enthalpy recovery sections to recover up to 80 percent of the total energy in the air stream. Indirect evaporative coolers also will be installed on these units to pretreat the air before cooling it with energy from the central plant. The cooling coils will use dew point controllers to measure and control the amount of cooling for dehumidification, which will minimize the amount of reheating.

To further reduce the energy wasted in air-conditioning unoccupied spaces, the team will use night setback controls and variable air volume technology at the supply diffusers, and reset the water temperatures. The new control strategy will eliminate the energy demands of over dehumidifying and then rehumidifying the air.

This project will minimize energy waste between the points of combustion and the points of exhaust by increasing the efficiency of the air-conditioning process and limiting the amount of building exhaust air. This will lower the amount of waste exhaust air by approximately 75 percent. The team will convert once-through water cooling systems to cooling recirculation systems (e.g., air compressors, engine radiators, and process chillers). Steam reheat coils that are presently leaking raw steam into the spaces (requiring additional dehumidification) will be replaced with new AHUs.



A MORE EFFICIENT HEATING AND COOLING PLANT

The existing heating and cooling plant will be replaced and upgraded with highly efficient equipment. Three existing 1,000-ton CFC-based electric chillers, cooling towers, pumps, and ancillary equipment will be decommissioned. The new chilled water plant will consist of 900 tons of high-efficiency, double-effect chiller/heaters, which do not use CFC or HCFC refrigerants. The new chiller/heaters will come equipped with units to recover waste heat from the condensers in the cooling cycle. The chiller/heaters will recover up to 25 percent of the input energy from the condenser water stream. This water will be used for the reheat coil loop feeding the AHUs. A new fuel cell will contribute its entire thermal output to feed the reheat coil loads.

The existing chemical water treatment system will be replaced with an ozone water treatment system that will reduce the amount of blow down water, eliminate the need to chemically treat the water, and provide a modest increase in chiller plant efficiency due to reduced scaling of the tube bundle. The chiller transformers will be decommissioned with the removal of the three chillers. These units have I2R losses, as well as idle losses, that will be removed from the system. Pumping energy will be conserved by matching the pumps to the pumping load. Wasted energy will be reduced from oversized pumps with closed balancing valves by trimming the impellers to maximize efficiency.

The existing 700 HP boilers also will be removed from the site. The team will replace oversized boilers at the central plant with new high-efficiency condensing boilers incrementally sized to operate at the most efficient operation. The 35 psi steam plant and all steam equipment will be removed, and the heating system will be converted to hot water. During the cooling season, the base reheating load will be serviced by energy recovery hot water from the chiller/heater and the waste heat from the fuel cell. Any remaining reheat load will be provided by a series of high-efficiency (93 percent) condensing boilers.

During the heating season, the chiller/heaters will perform the majority of the heating at a rated efficiency of 85 to 93 percent. The high-efficiency condensing boilers also can operate during heating days. Existing domestic water heaters that use steam for heating will be replaced with high-efficiency gas-fired units. The energy-efficient measures in the central plant will raise the heating C_0p to 78 percent from 37 percent. The new chiller/heaters and supplemental boilers are high-efficiency units, equipped with low NOx burners that will further reduce source emissions.

A natural gas fuel cell will be installed to provide both base load power and emergency backup for the facility. The phosphoric acid fuel cell, which will consume natural gas, will generate 200 kW of power for the site. This fuel cell also will provide heating water for the reheat water loop serving the AHUs. This clean power is ideal for the computer room electrical requirements. The application of the fuel cell at NVFEL is truly a cogeneration application since the entire thermal load will be used during the heating and cooling seasons. This technology has a proven track record for reliability, and it produces clean power and heat efficiently and inexpensively.

By integrating the heating and cooling plant, EPA will recover a high degree of energy that would have otherwise been exhausted in cooling towers or radiators. Energy that is presently exhausted out of the building either will be reconditioned and recirculated or recovered from the exhaust air via total energy recovery devices.

In addition to minimizing energy consumption, EPA will replace devices that use domestic water for once-through cooling. New air cooled condensers and fluid coolers will be installed on the process chillers, air compressors, and engine radiators to eliminate the use of once-through cooling. This will result in a water savings of 24 million gallons annually.

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